



University of Groningen

The changing impact of a severe disaster on the mental health and substance misuse of adolescents: follow-up of a controlled study

Reijneveld, S.A.; Crone, M.R.; Schuller, A.A.; Verhulst, F.C.; Verloove-Vanhorick, S.P.

Published in:
Psychological Medicine

DOI:
[10.1017/S0033291704003575](https://doi.org/10.1017/S0033291704003575)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Early version, also known as pre-print

Publication date:
2005

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Reijneveld, S. A., Crone, M. R., Schuller, A. A., Verhulst, F. C., & Verloove-Vanhorick, S. P. (2005). The changing impact of a severe disaster on the mental health and substance misuse of adolescents: follow-up of a controlled study. *Psychological Medicine*, 35, 367 - 376. <https://doi.org/10.1017/S0033291704003575>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

The changing impact of a severe disaster on the mental health and substance misuse of adolescents: follow-up of a controlled study

SIJMEN A. REIJNEVELD^{1,2*}, MATHILDE R. CRONE²,
ANNEMARIE A. SCHULLER², FRANK C. VERHULST³
AND S. PAULINE VERLOOVE-VANHORICK^{2,4}

¹ Groningen University, Department of Health Sciences, Groningen, Northern Centre for Healthcare Research, The Netherlands; ² TNO (Netherlands Organisation of Applied Scientific Research) Prevention and Health, Leiden, The Netherlands; ³ Erasmus Medical Center/Sophia Children's Hospital, Rotterdam, The Netherlands; ⁴ Leiden University Medical Center, Department of Pediatrics, Leiden, The Netherlands

ABSTRACT

Background. Disasters are believed to have large effects on the mental health of adolescents but the lack of prospective pre- and post-disaster data on affected and control populations have limited our knowledge on the validity of these claims. We examined the medium-term, 12 months' effects of a severe disaster on the mental health of adolescents, and compared them to effects after 5 months.

Method. A café fire in The Netherlands injured 250 adolescents and killed 14. We obtained data 15 months before and 12 months after the disaster about behavioural and emotional problems (using the Youth Self-Report) and substance misuse, in 124 students of an affected school of whom 31 were present at the fire (response 77.5%) and 830 other students (56.4%); mean age at baseline, 13.8 years.

Results. We found differences between students from the affected school and others for excessive use of alcohol (odds ratio 3.42, 95% confidence interval 2.00–5.85, $p < 0.0001$), but not for behavioural and emotional problems and use of other substances. Effects had decreased compared to those after 5 months.

Conclusions. In the long run, the effects of disaster decrease regarding self-reported behavioural and emotional problems, but they remain regarding alcohol misuse among those present at the disaster, and their peers.

INTRODUCTION

Clinical experience shows that disasters have profound effects on the mental health of children and adolescents. Reviews summarizing outcomes of disasters show a variety of effects on the mental health of children and adolescents (Aptekar & Boore, 1990; Vogel & Vernberg, 1993; Bromet & Dew, 1995; Bolton *et al.* 2000).

The effects include symptoms of depression and anxiety, concentration problems, memory loss, conduct disorder, school problems, substance abuse and sleep problems (Vogel & Vernberg, 1993; Bromet & Dew, 1995; Bolton *et al.* 2000; Yule *et al.* 2000).

Disasters occur unexpectedly and studies into their effects are, therefore, planned post-disaster. Studies in which prospective data were collected pre- and post-disaster in an affected and a control population have, therefore, not been available (Aptekar & Boore, 1990; Rubonis

* Address for correspondence: Professor Sijmen A. Reijneveld, Groningen University, Department of Health Sciences, PO Box 196, 9700 AD Groningen, The Netherlands.
(Email: S.A.Reijneveld@med.rug.nl)

& Bickman, 1991; Bromet & Dew, 1995). By coincidence, however, a severe disaster, the Volendam New Year's Eve café fire, affected the students of one of the three schools that was participating as control group in an ongoing quasi-experimental study. The disaster concerned a short but very intense fire during New Year's Eve 2000/2001 in a popular youth café in Volendam, wounding approximately 250 youngsters of whom 231 had to be hospitalized and 14 were killed. Almost all victims were students of the two Volendam secondary schools; the majority from the school that participated in our study (Boxma *et al.* 2001; Committee of Inquiry, 2001). For the original quasi-experimental study, we had already collected data on behavioural and emotional problems 15 months before the disaster, using the Youth Self-Report (YSR; Achenbach, 1991; Verhulst *et al.* 1997, 2003), and on substance misuse among all level 2 students of the three participating schools ($n=954$). Among these were 124 students from the affected school of whom 31 were in the fire.

In a previous paper, we reported on the short-term effects (after 5 months) of this disaster and demonstrated that, compared to adolescents from non-affected schools, adolescents from the affected school showed higher increases in behavioural and emotional problems as measured by the YSR, especially regarding the Anxious/Depressed, Thought Problems, and Aggressive Behaviour syndrome scales, and an increase in excessive use of alcohol. The use of tobacco, marijuana, ecstasy (MDMA) and sedatives had not risen (Reijneveld *et al.* 2003). For the original study, a second (and final) follow-up measurement had been planned 12 months after the disaster.

The aim of the present study is to examine the medium-term effects, after 12 months, of this severe disaster on the mental health, including substance misuse, of adolescents, using prospective pre- and post-disaster data. We analysed our observational data following the CONSORT criteria for the analysis of randomized controlled trials (Moher *et al.* 2001), in order to provide maximum of information. Our study resembled an actual experiment in which adolescents would be assigned to groups, a design known as a 'natural experiment' (Rothman & Greenland, 2001).

METHOD

Participants

The three schools that participated in the original study offered the entire range of secondary education, from low to high level. The affected school was located in the west of The Netherlands; both control schools were central, approximately 80 km from the affected school, and remained unaffected by disasters.

A total of 954 adolescents provided baseline data (affected school $n=124$; control schools $n=830$). Table 1 gives baseline characteristics of all adolescents. The affected school and the control schools differed significantly with regard to several demographic baseline measures, representing the different nature of the three schools, the affected school and one control school being denominational.

In total, 734 (76.9%) and 560 students (58.5%) completed the first and second follow-up measurements respectively. Loss to follow-up did not differ by type of school at the first follow-up measurement ($p=0.31$), but did at the second ($p=0.001$; response at affected school 71.8%, at control schools 56.4%). Fig. 1 shows participant flow and follow-up. The groups that provided data on the first and second follow-up measurements differed from those who were lost to follow-up regarding age (both follow-up measurements), gender (second follow-up measurement) and most outcome measurements (follow-up measurements). However, all differences by follow-up status were similar for the affected and the control schools. Of the participating students of the affected school, 31 were in the fire (of whom 17 were injured). Their response was similar to that of other students of the affected school at the second follow-up measurement (71.0% *v.* 72.0%, $p=0.91$) whereas it had been much lower at the first follow-up measurement (45.2% *v.* 82.8%, $p<0.0001$).

Medical Ethical Committee

The original study protocol had been approved by the Institutional Review Board (IRB) of our institute and consent from the parents' council of each school had been obtained. The secretary of the IRB was informed of the disaster. Continuation of the study was agreed upon with the management of the affected school.

Table 1. *Characteristics of all participating adolescents*

	Affected (n = 124)	Control (n = 840)	p value‡	p value for differences between analysed and lost to follow-up†	
				First follow-up	Second follow-up
No (%) girls	78 (62.9)	402 (48.4)	0.003 ^a	0.80 ^a	0.005 ^a
Mean (95% CI) age (years)	13.64 (13.56–13.71)	13.78 (13.74–13.81)	0.004 ^c	0.004 ^c	0.033 ^c
No (%) aged 14 years and over	29 (16.1)	234 (28.2)	0.005 ^a	0.007 ^a	0.011 ^a
No (%) following low-level education	47 (37.9)	446 (53.9)	0.001 ^a	0.70 ^a	0.97 ^a
No (%) of non-Dutch ethnic background	3 (2.5)	77 (9.4)	0.011 ^a	0.29 ^a	0.072 ^a
No (%) of Christian religion	83 (68.6)	208 (25.9)	<0.0001 ^a	0.76 ^a	0.34 ^a
No (%) of other religion	5 (4.1)	104 (13.0)			
No (%) with no parent working > 3 days/week	14 (11.3)	119 (14.5)	0.33 ^a	0.78 ^a	0.75 ^a
No (%) with clinical YSR Total Problems score	14 (11.3)	108 (13.1)	0.59 ^a	0.003 ^a	0.006 ^a
No (%) using alcohol excessively in preceding 2 weeks	18 (14.5)	136 (16.4)	0.60 ^a	0.009 ^a	0.023 ^a
No (%) smoking in preceding month	13 (10.5)	143 (17.2)	0.058 ^a	<0.0001 ^a	0.053 ^a
No (%) using marijuana ever	2 (1.6)	36 (4.3)	0.22 ^b	0.004 ^a	0.006 ^a
No (%) using ecstasy ever	0 (0.0)	6 (0.7)	1.00 ^b	0.63 ^b	0.088 ^b
No (%) using hypnotic/sedative ever	3 (2.4)	28 (3.4)	0.79 ^b	0.22 ^a	0.009 ^a
Response first follow-up measurement	91 (73.4)	643 (77.5)	0.31 ^a		
Response second follow-up measurement	90 (72.6)	467 (56.3)	0.001 ^a		

Data were missing for some adolescents regarding: level of education, 3; parental employment, 11; ethnicity, 18; religion, 30; for age and gender no missing values occurred.

^a χ^2 test.

^b Fisher's exact test.

^c *t* test.

† *p* values for differences between the total analysed group and the total group lost to follow-up. For all characteristics that showed statistically significant differences in loss to follow-up, these differences did not vary with statistical significance between schools (affected or control).

‡ *p* values for differences between the affected and the control group at baseline.

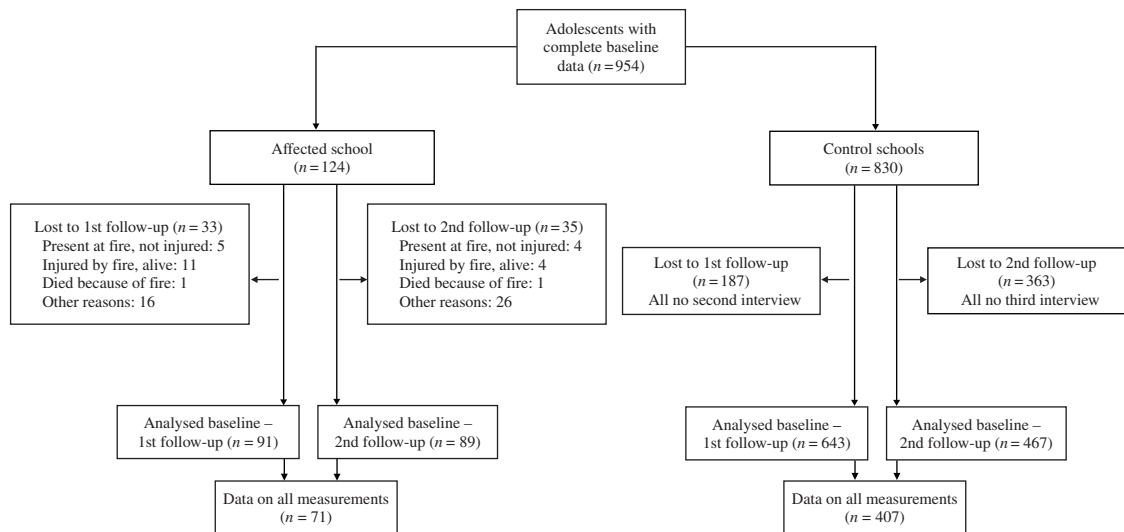


FIG. 1. Participant flow and follow-up.

Measures and end-points

In September/October 1999, 15 months pre-disaster, all students in grade 2 of all three schools had completed a baseline questionnaire in class comprising the YSR (Achenbach, 1991; Verhulst *et al.* 1997, 2003), questions on smoking (Kremers *et al.* 2001), and use of alcohol, marijuana, sedatives and hypnotics (tranquilizers), and ecstasy. YSR, smoking and use of alcohol were the primary end-points of the original study, and remained so in the post-disaster analyses. The YSR was used to assess the adolescents' reports on behavioural and emotional problems in the preceding 6 months. Its (good) reliability and validity have been replicated for the Dutch translation (Achenbach, 1991; Verhulst *et al.* 1997, 2003). We further obtained data on gender, age, level of education (lower *versus* higher), ethnic background (of child and both parents at least two born in The Netherlands *versus* elsewhere), religion (Christian, other, or none), and parental employment (one or both parents working >3 days per week *versus* else).

As planned, all students completed the same questionnaires in May 2001 and January 2002. To ensure comparability of information, we took no specific measures to increase the response of Volendam adolescents. However, we added some questions at the end of the first follow-up questionnaires regarding exposure to the café fire, and on school-based post-disaster care. The school management provided data on fire exposure for non-respondents on the first follow-up questionnaire. Information sources were anonymous and could only be linked through school code, gender, date of birth and initials of the adolescent.

For the analyses, all outcome measures were dichotomized, using cut-offs as planned in the original study. We computed scores for the nine YSR syndrome scales, the two broad-band groups of syndromes designated Internalizing and Externalizing (each comprising syndrome scales, covering emotional and behavioural problems respectively), and the Total Problems scale. The YSR problems scores were allocated to a clinical (coding in regression = 1) or a normal range (0), using the 98th percentile of the Dutch normative sample as cut-off for the syndrome scores and the 90th percentile for the

Internalizing, Externalizing and Total Problems scores (Verhulst *et al.* 1997). Smoking was categorized as at least one cigarette per month (1) *versus* less (0), use of alcohol as at least five drinks on one occasion in the two preceding weeks (further called excessive use of alcohol, 1) *versus* less (0), and use of other psychoactive substances as at least once (1) *versus* never (0).

Analysis strategy

First we compared the adolescents of the affected school and of the control schools regarding individual changes between baseline and second follow-up in all outcome measures (with adjustment for baseline values), using logistic regression. Previous studies have shown that the impact of disasters differs by gender and by exposure to the disaster (Vogel & Vernberg, 1993; Bromet & Dew, 1995; Bolton *et al.* 2000). Therefore, we next examined differences in effects by gender, by introducing an interaction term with gender in the models, and by exposure, separately comparing Volendam adolescents who were and who were not in the fire with the reference group. Finally, we computed prevalence rates regarding the primary outcomes and regarding the outcomes showing statistically significant short-term changes for all adolescents with data on each follow-up measurement.

Adolescents attending the three schools involved may differ in background characteristics that affect the outcomes. We, therefore, repeated all analyses adjusting for background characteristics that have been shown to affect changes in time of the mental health of adolescents or that showed statistically significant differences between the affected and the control schools. We also carried out an intention-to-treat (ITT) analysis, in which we analysed data from all adolescents, including those lost to follow-up. For the latter, we assumed no change since baseline measurement. Finally, we repeated the analyses regarding the YSR with continuous instead of dichotomized outcomes. All reported *p* values are two-sided and have not been adjusted for multiple comparisons.

Blinding

All adolescents were informed at baseline of the nature of the original study and that a second

Table 2. Differences in outcomes between the affected and the control adolescents regarding behavioural and emotional problems reported on the Youth Self-Report, excessive use of alcohol, smoking and use of marijuana, ecstasy, and hypnotics and sedatives

	Difference in change between groups (12 months' period, baseline – Second follow-up)		Difference in change between groups (5 months' period, baseline – First follow-up)	
	OR (95% CI) ^a	Adj. OR (95% CI) ^{ab}	OR (95% CI) ^a	Adj. OR (95% CI) ^{ab}
Clinical score on				
Total Problems (<i>n</i> = 89/461) ^c	1.52 (0.82–2.81)	1.54 (0.77–3.08)	1.82 (1.01–3.29)*	1.67 (0.88–3.20)
Internalizing Problems (<i>n</i> = 89/461) ^c	1.50 (0.79–2.84)	1.48 (0.72–3.02)	1.71 (0.91–3.22)	1.70 (0.85–3.37)
Externalizing Problems (<i>n</i> = 89/461) ^c	0.91 (0.46–1.81)	1.08 (0.51–2.32)	1.41 (0.76–2.64)	1.62 (0.82–3.22)
Anxious/Depressed (<i>n</i> = 89/461) ^c	2.12 (0.90–4.99)	1.84 (0.71–4.76)	2.85 (1.23–6.61)*	3.20 (1.26–8.09)*
Thought Problems (<i>n</i> = 89/461) ^c	1.13 (0.54–2.34)	1.06 (0.47–2.38)	2.16 (1.09–4.30)*	2.54 (1.19–5.44)*
Aggressive Behaviour (<i>n</i> = 89/461) ^c	0.54 (0.12–2.35)	0.58 (0.12–2.88)	3.30 (1.30–8.36)*	3.71 (1.28–10.7)*
Excessive use of alcohol (<i>n</i> = 89/466) ^c	3.41 (1.99–5.83)***	4.77 (2.62–8.68)***	4.57 (2.73–7.64)***	5.09 (2.94–8.80)***
Tobacco smoking (<i>n</i> = 87/461) ^c	1.14 (0.67–1.93)	1.09 (0.61–1.95)	0.87 (0.48–1.56)	0.88 (0.47–1.65)
Use of marijuana (<i>n</i> = 89/463) ^c	0.93 (0.51–1.72)	1.19 (0.61–2.33)	0.99 (0.48–2.02)	1.54 (0.71–3.33)
Use of ecstasy (<i>n</i> = 89/464) ^c	0.99 (0.33–2.96)	1.19 (0.35–3.99)	0.49 (0.06–3.74)	1.21 (0.14–10.6)
Use of hypnotics/sedatives (<i>n</i> = 89/464) ^c	2.42 (1.06–5.54)*	1.78 (0.72–4.42)	2.03 (0.85–4.82)	1.96 (0.77–5.00)

Statistically significant differences ($p < 0.05$) are in bold; * $p < 0.05$, *** $p < 0.001$.

^a Value of outcome at second and first measurement respectively, adjusted for the value of this outcome at the baseline measurement

^b Adjusted for gender, age, level of education, ethnic background and religion.

^c Numbers of respondents with complete data on the second follow-up measurement in affected school and control schools, respectively. For the first follow-up measurement these numbers varied from 81 to 87 for the affected school, and from 629 to 634 for the control schools.

The table shows relevant outcomes for students who provided data on the second follow-up and the baseline measurements. For the sake of comparison, similar data are provided regarding the first follow-up measurement (italicized).

measurement would occur. They were not aware of our specific interest in studying the effects of disaster.

RESULTS

Outcomes

Table 2 shows relevant outcomes for students who provided data on the second follow-up and baseline measurements. For comparison purposes, similar data are provided regarding the first follow-up measurement. Fig. 2 graphically displays prevalence rates regarding all students providing data on the measurement concerned. For the primary outcomes, increases from the baseline to the second follow-up measurements were larger at the affected school than at the control schools regarding excessive use of alcohol ($p < 0.0001$) but not regarding behavioural and emotional problems ($p = 0.18$), and smoking ($p = 0.64$). Regarding behavioural and emotional problems, differences between the affected school and the control schools decreased for the YSR syndromes that showed statistically significant differences at the first follow-up measurement (the Anxious/Depressed, Thought Problems, and Aggressive Behaviour syndrome

scales). For these and for all other YSR syndrome scales (not shown), differences were not statistically significant at the second follow-up measurement. For the secondary outcome use of sedatives, the affected and control schools differed with statistical significance at the second follow-up measurement, whereas they did not at the first follow-up. Adjustment for background characteristics diminished differences somewhat. Additional analyses further show that adolescents with a clinical YSR Total Problems score at the first follow-up measurement are much more likely to have started use of hypnotics and sedatives at the second follow-up (10.9% v. 2.1% for all others, $p = 0.003$, Fisher's exact test). Further, adolescents scoring in the clinical range of the YSR Total Problems score at the first follow-up measurement were slightly more likely to have initiated excessive alcohol use than others, but without statistical significance (45.5% v. 32.6%, $p = 0.15$, χ^2 test). However, excessive use of alcohol at the second follow-up measurement was higher among adolescents with a clinical YSR Total Problems score at both the first (53.0% v. 42.6%, $p = 0.038$, χ^2 test) and the second follow-up measurements (67.1% v. 53.3%, $p = 0.021$, χ^2 test). All

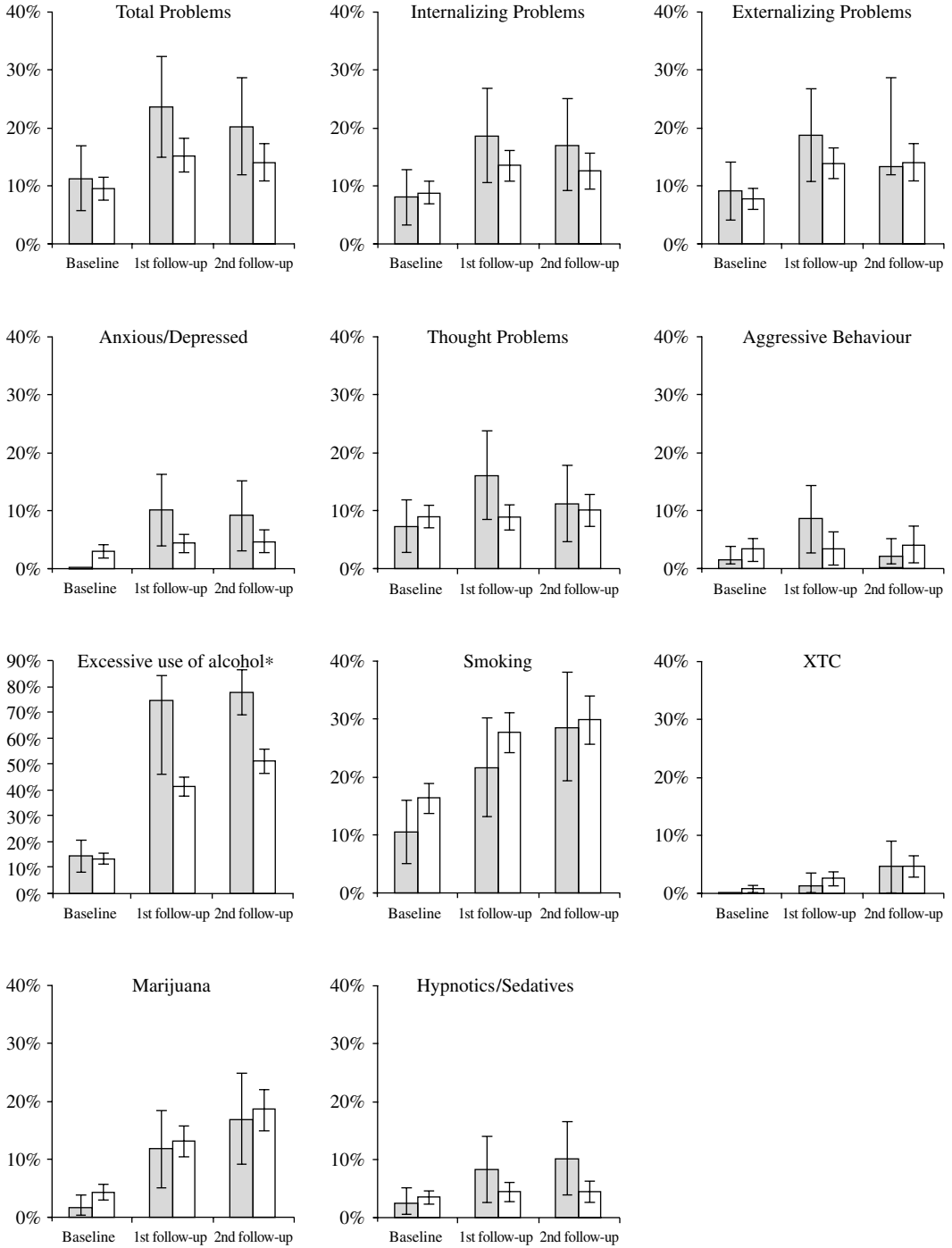


FIG. 2. Prevalence rates (95% confidence intervals) at the affected school (■) and the control schools (□) regarding behavioural and emotional problems reported on the Youth Self-Report, excessive use of alcohol, smoking and use of marijuana, ecstasy, and hypnotics and sedatives at the baseline and first and second follow-up measurements [total numbers of respondents at the baseline, and first and second follow-up measurements were (affected school/control schools): 124/830, 91/643, and 89/467 respectively]. * Scaling of the y-axis is different.

Table 3. Differences in 12 months' outcomes for non-exposed and exposed adolescents of the affected school compared with adolescents of the control schools who are the reference category (i.e. have an odds ratio of '1')

	Not in café during disaster (n=67)		In café during disaster (n=22)	
	OR (95% CI)	Adj. OR (95% CI) ^a	OR (95% CI)	Adj. OR (95% CI) ^a
Clinical score on				
Total Problems	1.39 (0.68–2.85)	1.39 (0.64–3.01)	2.02 (0.71–5.77)	2.06 (0.67–6.31)
Anxious/Depressed	1.70 (0.62–4.70)	1.54 (0.52–4.57)	3.22 (0.88–11.8)	2.89 (0.71–11.7)
Thought Problems	1.29 (0.57–2.89)	1.16 (0.48–2.78)	0.81 (0.18–3.66)	0.78 (0.16–3.70)
Aggressive Behaviour	0.35 (0.05–2.62)	0.34 (0.04–2.81)	1.08 (0.14–8.47)	2.03 (0.23–18.3)
Excessive use of alcohol	3.24 (1.77–5.91)***	4.08 (2.15–7.37)***	4.84 (1.37–17.1)*	9.37 (2.43–36.2)**
Use of hypnotics/sedative	1.70 (0.61–4.74)	1.31 (0.44–3.89)	4.48 (1.37–14.7)*	3.39 (0.95–12.1)

Statistically significant differences ($p < 0.05$) are in bold; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

^a Adjusted for gender, age, level of education, ethnic background and religion.

aforementioned associations were similar for students of the affected and the other schools. Regarding the other secondary outcomes, use of marijuana, and ecstasy, outcomes were rather similar for both groups at both follow-up measurements.

Adjustment for background characteristics on which the affected school and the control schools differed with statistical significance at baseline (gender, age, level of education, ethnicity, and religion) yielded similar results. ITT analysis also yielded similar results (not shown) except for the YSR syndrome scale Anxious/Depressed, for which differences increased somewhat [crude and adjusted odds ratios (95% confidence intervals): 2.71 (1.17–6.29, $p = 0.020$), and 2.18 (0.88–5.43, $p = 0.09$).

Subgroups

Regarding *gender*, all differences between the affected school and the control schools were larger for girls than for boys, but none with statistical significance (results not shown). The increases in outcomes did not differ with statistical significance by *exposure to the disaster*, although they were larger for Volendam adolescents who were present at the fire (Table 3). It should be realized, however, that this concerned a small group. Regarding *participants for whom data were available on all three measurements* (affected school, $n = 71$; control schools, $n = 407$), results were very similar to those for all participants (not shown). Regarding the YSR outcomes, results were similar if we used *continuous* instead of dichotomized scores as outcome (results not shown).

DISCUSSION

Our study examined the medium-term impact, after 12 months, of a severe disaster on mental health, including substance use, of adolescents in a study with prospective pre- and post-disaster data on an affected and a control population. Its results show that the impact on mental health has decreased after 12 months, compared to the situation after 5 months. Decreases especially concerned those symptoms that showed large short-term (5 months), increases, i.e. self-reported anxiety, depression, thought problems and aggression. The increases in excessive use of alcohol remained, however, and the impact of the disaster on the use of hypnotics and sedatives had increased, although not statistically significant after adjustment for differences in background characteristics. Effects tended to be somewhat larger for girls, although without statistical significance. Moreover, medium-term effects were somewhat larger for those present at the fire, but again without statistical significance, whereas they were rather similar at the short-term.

Regarding the level of behavioural and emotional problems, our results confirm those of earlier studies with only post-disaster data or without a control group, that show that the mental health effects of disasters are smaller the longer the time after the disaster they are measured (Rubonis & Bickman, 1991; Vogel & Vernberg, 1993; Bromet & Dew, 1995; Bolton *et al.* 2000). It should be realized, however, that some of these effects may persist. Young British people who as teenagers had survived a shipping disaster were most likely to develop problems

within 6 months after the disaster (Yule *et al.* 2000), but 5–8 years later they were still more likely than controls to have anxiety and affective disorders (Bolton *et al.* 2000). Of the survivors of the UK Aberfan disaster that killed 116 children and affected 145 others, 29% still met criteria for PTSD 33 years later, whereas 46% had done so at some moment during those 33 years (Morgan *et al.* 2003). Children experiencing heavy bush fires in Australia when aged 5–12 years initially showed few mental health symptoms, but did so after 8 and 26 months with rather similar symptom levels (McFarlane *et al.* 1987). In contrast, child survivors (2–15 years) of the US Buffalo Creek dam collapse had recovered from most psychiatric symptoms 17 years after the disaster, but substance abuse had emerged as a new problem during this follow-up period (Green *et al.* 1994). Finally, Ukrainian children who had been evacuated from the Chernobyl area when aged 0–15 months perceived their mental health similarly to their unaffected classmates (Bromet *et al.* 2000).

A disconcerting finding in our study was the long-lasting effect of the disaster on alcohol use of the adolescents in our sample. Among adults substance abuse is a well-documented factor accompanying PTSD (Breslau *et al.* 1991). Regarding adolescents, Yule and co-workers found a two-fold increase in substance abuse among survivors of the aforementioned shipping disaster but without statistical significance (Yule *et al.* 2000). Some investigators have also documented an increased prevalence of substance abuse, independent from PTSD, among people experiencing disaster as adults (Joseph *et al.* 1993; Vlahov *et al.* 2002), or as children (Green *et al.* 1994). It may be that some of the adolescents used this to alleviate symptoms of anxiety and depression, at least in the short term. We do not as yet know if this strategy is an unwanted but temporary way of coping, or the beginning of a longer-lasting more general dependence on psychoactive substances (Rohde *et al.* 2001).

Limitations

Differences between the two groups, imprecise information and the effect of post-disaster interventions may have influenced our findings, but if at all present they will have caused an underestimation of the real effects. First, 41.5%

of all adolescents (affected school, 27.4%; control schools, 43.6%) were lost to follow-up. However, ITT analysis provides very similar effect estimates. Compared to the 5 months' follow-up measurement, response was much higher among adolescents who were in the fire, and was similar to the other affected adolescent at the 12 months' follow-up. This confirms our previous assumption that factors directly related to the fire, like being hospitalized, explained this initially higher non-response, and not a general tendency of these adolescents to drop out (Reijneveld *et al.* 2003). Our results thus probably provide a valid estimate of the medium-term effects among adolescents from the affected school, but we can not exclude bias among those from the control schools because of the relatively high loss to follow-up among them. Furthermore, our comparison concerned entire schools, i.e. a natural experiment on only three communities. Differences in age of onset of substance use across schools could have biased our findings.

Imprecision of the self-reported data might have affected our outcomes but this is unlikely as we have previously indicated (Rohde *et al.* 2001). Answers were confidential and anonymous, which has been shown to lead to valid self-reported information on use of alcohol (Del Boca & Noll, 2000), on adolescent smoking (Stanton *et al.* 1996; Rebagliato, 2002), and on mental health (Boyle *et al.* 1997). Moreover, any bias in outcome measures, if existing, would probably affect all three measurements in both groups. However, a global measure for behavioural and emotional problems like the YSR may have missed some of the specific effects of disaster in children and adolescents (Vogel & Vernberg, 1993).

Finally, the immediate set-up of a treatment programme for all victims, both inside and outside the setting of the affected school, may have reduced the impact of the disaster (Pynoos *et al.* 1998; Yule, 2001). This may have led to an underestimation of the effects, especially among those present at the fire. In particular, those with the highest symptom levels at the first follow-up measurement were much more likely to have received hypnotics or sedatives at the second follow-up measurement. This can be interpreted as an indication of effective treatment that has reduced the symptoms among this group. In

The Netherlands, the quality of post-disaster public mental health interventions has improved, due to a decade of experience with a number of manmade disasters (Reijneveld, 1994), that has given impetus to a much better coordination of post-disaster care, and the set-up of long-term aftercare programmes.

Clinical implications

Post-disaster health care for adolescents should aim at the physical and psychosocial consequences of the disaster (Larkin, 1998; Pynoos *et al.* 1998). Our findings on short-term effects indicated the need for services aiming at the negative mental health effects of exposure to disaster, including anxiety, depression, incoherent thinking, aggression, and substance abuse (Aptekar & Boore, 1990; Vogel & Vernberg, 1993; Bromet & Dew, 1995; Bolton *et al.* 2000; Udwin *et al.* 2000). Our medium-term results indicate that the effects on excessive use of alcohol among adolescents are longer lasting and that the effects on the use of hypnotics and sedatives may increase. This stresses the need for services aiming at these two problems, to prevent a more general substance abuse or even dependence. School-based prevention programmes may provide a means for this as this seems to be the most effective route for such prevention, although its effectiveness still has to be improved (Weinberg *et al.* 1998, 2002; Foxcroft *et al.* 2002). Furthermore, selective preventive interventions aiming at high-risk adolescents like these and including the involvement of both adolescents and their parents (Cuijpers, 2002; Foxcroft *et al.* 2002) may be effective in reducing substance use including alcohol misuse (Foxcroft *et al.* 2002; Weinberg *et al.* 2002).

Similar to the short-term effects, medium-term effects are very comparable among Volendam adolescents who had and who had not been at the fire. Likely explanations are traumatic experiences such as the loss of classmates, friends, brothers and sisters, and the daily confrontation with deformed and handicapped victims. Those not directly exposed individuals should thus be actively involved in post-disaster care programmes. However, of all Volendam adolescents with a positive score on an initial screening only a quarter were willing to participate in such programmes

(Wolleswinkel-van den Bosch, 2003). On the other hand, adolescents may also obtain adequate help through regular care; at least their contact rates with primary care have greatly increased since the disaster (Dorn *et al.* 2003).

Implications for research

Our results need confirmation in other situations, with other age groups and with clinical assessments of mental health, and with a still longer follow-up. These may also provide evidence for risk factors regarding the development of mental problems after trauma and for exposure to trauma, such as pre-existent mental problems in individuals or their families (Bromet & Dew, 1995; Breslau *et al.* 1997; Silberg *et al.* 2001; Koenen *et al.* 2002), family disruption after the disaster (Bromet & Dew, 1995), and genetic make-up (Silberg *et al.* 2001; Stein *et al.* 2002; Koenen *et al.* 2002). It may further provide more evidence on the effects of disasters on substance abuse. A next step will be to obtain high-quality evidence on the treatment of these victims, regarding both mental health and substance abuse (Pfefferbaum, 1997; Yule 2001).

ACKNOWLEDGEMENTS

This study was financially supported by the Dutch Ministry of Public Health, the municipality Edam-Volendam, the Don Bosco College, Volendam, and the Volendam Centre on Post-disaster care het Anker. The original study was financially supported by grant 9607-021-3 from the Dutch Health Research and Development Council (ZonMw). We thank the Don Bosco College for assisting in the data collection.

DECLARATION OF INTEREST

None.

REFERENCES

- Achenbach, T. M. (1991). *Manual for the Youth Self-Report and 1991 Profile*. University of Vermont, Department of Psychiatry, Burlington, VT.
- Aptekar, L. & Boore, J. A. (1990). The emotional effect of disaster on children: a review of the literature. *International Journal of Mental Health* 19, 77–90.
- Bolton, D., O’Ryan, D., Udwin, O., Boyle, S. & Yule, W. (2000). The long-term psychological effects of a disaster experienced in adolescence. II: general psychopathology. *Journal of Child Psychology and Psychiatry, and Allied Disciplines* 41, 513–523.

- Boxma, H., Dokter, J. & Welvaart, W. N. (2001). Use of trauma triage teams at the café fire in Volendam [in Dutch]. *Nederlands Tijdschrift voor Geneeskunde* **145**, 2321–2326.
- Boyle, M. H., Offord, D. R., Racine, Y. A., Szatmari, P., Sanford, M. & Fleming, J. E. (1997). Adequacy of interviews vs checklists for classifying childhood psychiatric disorder based on parent reports. *Archives of General Psychiatry* **54**, 793–799.
- Breslau, N., Davis, G. C., Andreski, P. & Peterson, E. (1991). Traumatic events and posttraumatic stress disorder in an urban population of young adults. *Archives of General Psychiatry* **48**, 216–222.
- Breslau, N., Davis, G. C., Andreski, P., Peterson, E. L. & Schultz, L. R. (1997). Sex differences in posttraumatic stress disorder. *Archives of General Psychiatry* **54**, 1044–1048.
- Bromet, E. & Dew, M. A. (1995). Review of psychiatric epidemiologic research on disasters. *Epidemiologic Reviews* **17**, 113–119.
- Bromet, E. J., Goldgaber, D., Carlson, G., Panina, N., Golovakha, E., Gluzman, S. F., Gilbert, T., Gluzman, D., Lyubsky, S. & Schwartz, J. E. (2000). Children's well-being 11 years after the Chernobyl catastrophe. *Archives of General Psychiatry* **57**, 563–571.
- Committee of Inquiry, Café Fire New Year's Eve 2001 (2001). Café Fire: final report [in Dutch]. Ministry of Internal Affairs, The Hague.
- Cuijpers, P. (2002). Effective ingredients of school-based drug prevention programs. A systematic review. *Addictive Behaviors* **27**, 1009–1023.
- Del Boca, F. K. & Noll, J. A. (2000). Truth or consequences: the validity of self-report data in health services research on addictions. *Addiction* **95** (Suppl. 3), S347–S360.
- Dorn, T., Kerssens, J. J., ten Veen, P. M. H. & IJzermans, C. J. (2003). *Health Problems and the Volendam New Year's Eve Fire* [in Dutch]. NIVEL, Utrecht.
- Foxcroft, D. R., Ireland, D., Lister-Sharp, D. J., Lowe, G. & Breen, R. (2002). Primary prevention for alcohol misuse in young people. *Cochrane Database of Systematic Reviews*, no. 3, CD003024.
- Green, B. L., Grace, M. C., Vary, M. G., Kramer, T. L., Gleser, G. C. & Leonard, A. C. (1994). Children of disaster in the second decade: a 17-year follow-up of Buffalo Creek survivors. *Journal of the American Academy of Child and Adolescent Psychiatry* **33**, 71–79.
- Joseph, S., Yule, W., Williams, R. & Hodgkinson, P. (1993). Increased substance use in survivors of the Herald of Free Enterprise disaster. *British Journal of Medical Psychology* **66**, 185–191.
- Koenen, K. C., Harley, R., Lyons, M. J., Wolfe, J., Simpson, J. C., Goldberg, J., Eisen, S. A. & Tsuang, M. (2002). A twin registry study of familial and individual risk factors for trauma exposure and posttraumatic stress disorder. *Journal of Nervous and Mental Disease* **190**, 209–218.
- Kremers, S. P., Mudde, A. N. & De Vries, H. (2001). 'Kicking the initiation': do adolescent ex-smokers differ from other groups within the initiation continuum? *Preventive Medicine* **33**, 392–401.
- Larkin, M. (1998). Disaster-medicine teams must tackle mental health. *Lancet* **352**, 1606.
- McFarlane, A. C., Policansky, S. K. & Irwin, C. (1987). A longitudinal study of the psychological morbidity in children due to a natural disaster. *Psychological Medicine* **17**, 727–738.
- Moher, D., Schulz, K. F. & Altman, D. G. (2001). The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomised trials. *Lancet* **357**, 1191–1194.
- Morgan, L., Scourfield, J., Williams, D., Jasper, A. & Lewis, G. (2003). The Aberfan disaster: 33-year follow-up of survivors. *British Journal of Psychiatry* **182**, 532–536.
- Pfefferbaum, B. (1997). Posttraumatic stress disorder in children: a review of the past 10 years. *Journal of the American Academy of Child and Adolescent Psychiatry* **36**, 1503–1511.
- Pynoos, R. S., Goenjian, A. K. & Steinberg, A. M. (1998). A public mental health approach to the postdisaster treatment of children and adolescents. *Child and Adolescent Psychiatric Clinics of North America* **7**, 195–210.
- Rebagliato, M. (2002). Validation of self reported smoking. *Journal of Epidemiology and Community Health* **56**, 163–164.
- Reijneveld, S. A. (1994). The impact of the Amsterdam aircraft disaster on reported annoyance by aircraft noise and on psychiatric disorders. *International Journal of Epidemiology* **23**, 333–340.
- Reijneveld, S. A., Crone, M. R., Verhulst, F. C. & Verloove-Vanhorick, S. P. (2003). The effect of a severe disaster on the mental health of adolescents: a controlled study. *Lancet* **362**, 691–696.
- Rohde, P., Lewinsohn, P. M., Kahler, C. W., Seeley, J. R. & Brown, R. A. (2001). Natural course of alcohol use disorders from adolescence to young adulthood. *Journal of the American Academy of Child and Adolescent Psychiatry* **40**, 83–90.
- Rothman, K. J. & Greenland, S. (2001). *Modern Epidemiology* (2nd edn). Lippincott: Philadelphia.
- Rubonis, A. V. & Bickman, L. (1991). Psychological impairment in the wake of disaster: the disaster-psychopathology relationship. *Psychological Bulletin* **109**, 384–399.
- Silberg, J., Rutter, M., Neale, M. & Eaves, L. (2001). Genetic moderation of environmental risk for depression and anxiety in adolescent girls. *British Journal of Psychiatry* **179**, 116–121.
- Stanton, W. R., McClelland, M., Elwood, C., Ferry, D. & Silva, P. A. (1996). Prevalence, reliability and bias of adolescents' reports of smoking and quitting. *Addiction* **91**, 1705–1714.
- Stein, M. B., Jang, K. L., Taylor, S., Vernon, P. A. & Livesley, W. J. (2002). Genetic and environmental influences on trauma exposure and posttraumatic stress disorder symptoms: a twin study. *American Journal of Psychiatry* **159**, 1675–1681.
- Udwin, O., Boyle, S., Yule, W., Bolton, D. & O'Ryan, D. (2000). Risk factors for long-term psychological effects of a disaster experienced in adolescence: predictors of post traumatic stress disorder. *Journal of Child Psychology and Psychiatry and Allied Disciplines* **41**, 969–979.
- Verhulst, F. C., Achenbach, T. M., van der Ende, J., Erol, N., Lambert, M. C., Leung, P. W., Silva, M. A., Zilber, N. & Zubrick, S. R. (2003). Comparisons of problems reported by youths from seven countries. *American Journal of Psychiatry* **160**, 1479–1485.
- Verhulst, F. C., van der Ende, J. & Koot, H. M. (1997). *Manual for the YSR* [in Dutch] Erasmus University/Dept of Child and Adolescent Psychiatry, Sophia Children's Hospital, Rotterdam.
- Vlahov, D., Galea, S., Resnick, H., Ahern, J., Boscarino, J. A., Bucvalas, M., Gold, J. & Kilpatrick, D. (2002). Increased use of cigarettes, alcohol, and marijuana among Manhattan, New York, residents after the September 11th terrorist attacks. *American Journal of Epidemiology* **155**, 988–996.
- Vogel, J. M. & Vernberg, E. M. (1993). Children's psychological responses to disasters. *Journal of Clinical Child Psychology* **22**, 464–484.
- Weinberg, N. Z., Rahdert, E., Collier, J. D. & Glantz, M. D. (1998). Adolescent substance abuse: a review of the past 10 years. *Journal of the American Academy of Child and Adolescent Psychiatry* **37**, 252–261.
- Weinberg, W. A., Harper, C. R. & Brumback, R. A. (2002). Substance use and abuse: epidemiology, pharmacological considerations, identification and suggestions towards management. In *Child and Adolescent Psychiatry* (4th edn) (ed. M. Rutter and E. Taylor), pp. 437–455. Blackwell Publishers: Oxford.
- Wolleswinkel-van den Bosch, J. H. (2003). *Identification Study Secondary School Students Volendam: the Mental Well-being of Adolescents after the Café Fire* [in Dutch]. Pallas: Rotterdam.
- Yule, W. (2001). Posttraumatic stress disorder in the general population and in children. *Journal of Clinical Psychiatry* **62** (Suppl. 17), 23–28.
- Yule, W., Bolton, D., Udwin, O., Boyle, S., O'Ryan, D. & Nurrish, J. (2000). The long-term psychological effects of a disaster experienced in adolescence. I: the incidence and course of PTSD. *Journal of Child Psychology and Psychiatry, and Allied Disciplines* **41**, 503–511.